# REPRODUCTIVE PERFORMANCE OF SHAGYA ARABIAN BROODMARES AT THE RĂDĂUȚI STUD FARM

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***Abstract***

*The quality of biological material and reproductive performance represents a constant focus in stud farm management. In this study, a group of 19 Shagya Arabian mares was monitored and evaluated for key reproductive traits. These females, promoted to broodmare status from the 2016–2018 generations, were part of the nucleus herd at the Rădăuți Stud Farm. The results showed that the mean age at first breeding was 1432.05 ± 22.49 days, while the mean age at first successful mating was 1397.53 ± 107.63 days. Gestation length, depending on the number of foalings, ranged from 337.08 ± 8.95 days to 347.20 ± 28.02 days. The average service period and foaling interval were 184.92 ± 251.00 and 367.08 ± 170.14 days. These findings are generally consistent with data reported in the scientific literature, as well as with values previously recorded in broodmares from earlier generations.*

***Key words:*** *broodmares, equines, reproduction, stud farm, performance*

## INTRODUCTION

Reproductive efficiency is one of the key factors ensuring the sustainability and genetic progress of horse breeding systems. In stud farms, the reproductive performance of broodmares directly influences the preservation of valuable genetic lines, the economic viability of the enterprise, and the conservation of breeds with historical and cultural significance.

In Romanian stud farms, most mares are typically bred around 1.460 days of age, but not later than 2.190 days. Their reproductive use generally extends up to 3.650 days, with breeding decisions influenced by the need to avoid infertility, the incidence of accidents, or the occurrence of foals considered unsuitable or susceptible to disease. This approach reflects the primary goal of these establishments: to produce high-quality biological material, ensuring that the resulting foals are of superior genetic and phenotypic value [1].

Gestation, defined as the period between successful insemination and parturition, averages 340 days in mares, with a range of 310–412 days. This length is influenced by mare age (longer in primiparous or older mares), foal sex (longer for males), climate (shorter in tropical regions), and management conditions (adequate nutrition and care can reduce gestation length) [1-3].

Regarding the service period, defined as the interval between parturition and the next successful insemination, mares typically resume ovarian activity immediately after foaling, provided the birth occurs without genital tract injury (60-90 days). Fertilization during the subsequent estrus is possible, although conception rates are reduced by approximately 20–25% compared to mares bred in other estrus periods [2].

The foaling interval, or the period between two consecutive foalings, averages 337–338 days in horses. Optimizing this

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interval while respecting gestation length and service period ensures the production of one foal per year without compromising the mare's health [2,3].

The Shagya Arabian, a breed developed in the Austro-Hungarian Empire starting the 18th century was originally created to meet the needs of the Austro-Hungarian cavalry, which required a more resilient and powerful horse than its ancestor, the noble and elegant Purebred Arabian. In 1789, the studbooks of the Rădăuți and Bábolna Stud Farms (the latter being an annex of the Mezőhegyes Stud Farm in Hungary) were established, recording that numerous transfers of breeding animals took place between the two units [4,10]. Today, the exceptional abilities of the Shagya Arabian in eventing (dressage, show jumping, cross-country), hunting, endurance, driving, and leisure riding have made the breed highly valued and sought after worldwide over the past half-century, while also contributing to the development of specialized breeds for performance in these disciplines [5].

In Romania, the Rădăuți Stud Farm has played a pivotal purpose in the preservation and amelioration of this genetic resource, representing one of the few centers in Europe where pure Shagya Arabian lines are still maintained under structured breeding programs (Shagya, Siglavy-Bagdady, Dahoman, Koheilan, Hadban, O'Bajan, Mersuch, El-Sbaa, and Gazal; the existing genealogical lines worldwide are:

Shagya, Gazal, Dahoman, Jussuf, Koheilan, O'Bajan, Hadban, Gidran, Siglavy-Bagdady, Mersuch, Amurath, Ibrahim, El Sbaa, and Kemir) [4].

Given the critical role of reproduction in stud farms, which is responsible for the preservation and perpetuation of the genetic material of a specific breed, a comprehensive analysis of the reproductive performance of Shagya Arabian mares at Rădăuți Stud Farm is therefore warranted to identify potential problems in reproduction management and strategies for optimizing this process.

## MATERIAL AND METHOD

In this study, a total of 19 Shagya Arabian mares were monitored and evaluated for key reproductive traits. These females, representing the El-Sbaa, Siglavy-Bagdady, Shagya, Dahoman, Gazal, Mersuch, and Koheilan bloodlines, belonged to the 2016–2018 generations and were promoted to the broodmare nucleus at Rădăuți National Stud Farm, in accordance with the authorization of the National Commission for the Evaluation and Classification of Purebred Horses, based on the results obtained in the qualification trials and the ranking activity carried out in 2024 [6]. The data obtained from the original reproduction registers of Rădăuți Stud farm [7] were centralized and statistically processed, with emphasis on descriptive indicators such as arithmetic mean ($\bar{x}$), variance ($s^2$), standard error of the mean ($\pm s_{\bar{x}}$), and coefficient of variation (V%), in order to assess the degree of variability of the reproductive traits. The statistical analysis was performed using GraphPad Prism and Microsoft Excel, which allowed both data processing and graphical representation of results.

The objective was to analyze the mean age at first breeding and at first successful mating, gestation length, the average value of service period and foaling interval, as these are the primary reproductive indices monitored in a stud farm where the continuity and genetic amelioration of a breed constitute the central focus. This analysis provides insights into the reproductive efficiency of Shagya Arabian broodmares and informs management decisions aimed at optimizing breeding programs and maintaining high-quality products which will be obtained in the next generations.

## RESULTS

According to the records of the Rădăuți Stud Farm, the average age at first mating for the 19 Shagya Arabian broodmares

included in the study was 3.92 years (1432 days), with individual values ranging from 3.1 to 4.3 years (1154–1550 days). Most mares were introduced to reproduction at 4.2 years of age, in accordance with the breeding practices applied in National Stud Farms. These values are close to those reported in the literature, which generally indicate 3–3.5 years as the optimal age for the first reproductive use [8-10].

The age at first successful mating was evaluated for the 15 mares that conceived, with a mean of 3.79 years (1397.53 days) and a range between 3.2 and 4.2 years. This parameter is a key indicator of reproductive maturity, marking the moment when the mare can sustain a full-term pregnancy with a viable foal. The obtained results are consistent with the recommended values (2.8–3.5 years) but also reflect the responsible practice at Rădăuți Stud Farm of obtaining the first foaling at approximately 4.5 years [11].

Gestation length varied depending on parity and biological factors. For the first gestation, the duration ranged between 328 and 444 days, with an average value of 347.2 days. For the second one, the mean length was 337.08 days (323–351 days), while the third gestation had a mean of 327.43 days (316–357). Variations were influenced by factors such as foal sex and breeding season, in line with observations reported for other horse breeds, where foalings occurring in winter or early spring are generally associated with longer gestations [12].

The service period (SP) showed a wide variability. After the first foaling, the mean SP was 210.62 days (12–798 days), whereas after the second foaling it averaged 113.86 days (12–358). Following the third foaling, the mean SP was 12 days, although this was recorded in only two mares. Overall, the mean SP across the studied mares was 184.92 days, which is considerably longer than the optimal interval of 60–90 days [12].

The foaling interval (FI) also reflected significant variability. After the first foaling, the mean FI was 495 days (344–761), while after the second foaling it averaged 412.17 days (329–655). The overall mean FI across the 15 mares was 367.08 days (172–696.5 days). In several cases, these values are higher than the optimal interval of 365–380 days, indicating that the strategic goal of obtaining one foal per mare per year was not consistently achieved. Prolonged intervals were associated with postpartum complications and conception failures at the first mating. Nevertheless, the general mean remained within the acceptable range for a stud farm with objectives of genetic conservation and breed amelioration [13].

## DISCUSSIONS

**Discussions on the age of introduction to reproduction** - this parameter represents a critical milestone in the management of horse populations, as it directly influences reproductive longevity, health status, economic efficiency, and the transmission of valuable genetic traits. In the case of Shagya Arabian breed, renowned for its elegance, endurance, and balanced temperament, this process requires careful planning and precise management strategies.

Although sexual maturity occurs at 18–24 months, mares are responsibly introduced to reproduction at around 3.5 years of age, with the first foaling expected at 4.5 years [4,8,9]. According to the data presented in Table 1, out of the 19 mares studied, four were introduced to reproduction at 4, 4, 4.1, and 4.2 years of age respectively. Two mares entered reproduction at 3.4 years, and another two at 4.3 years. Three mares were introduced at 3.1, 3.2, and 3.5 years, respectively.

When analyzing the age at first insemination in days, the mean for the entire group was 1432 days, ranging from 1154 to 1550 days. Considering age in years and

months, the mean age at introduction to reproduction was 3.92 years, with a range between 3.1 and 4.3 years

**Discussion on age at first successful insemination** – this parameter is a key parameter for assessing reproductive maturity and herd management. It indicates the point at which a mare is not only exhibiting estrous behavior but is also capable of carrying a full-term gestation resulting in a viable foal [4].

According to Table 2, among the 15 Shagya Arabian broodmares that were in foal (four mares did not conceive), the average age at first successful mating was 3.79 years, with a range from 3.2 to 4.2 years. The age at first successful mating, expressed in number of days, averaged 1397.53 days, with variations between 1173 days and 1575 days. The recommended and observed mean values for the optimal age at first successful mating are around 3 years (36 months), with variations between 2.8 and 3.5 years, depending on factors such as body growth rate, body condition, intended purpose (sport or reproduction), and the most favorable breeding season [5,8,11,13]. In Rădăuți Stud Farm, the first successful mating generally takes place in the spring of the year in which the mares reach 3.5 years of age, so that the first foaling occurs at approximately 4.5 years of age [13].

Table 1 The age of introduction to reproduction of Shagya Arabian broodmares

| Specification | The age of introduction to reproduction (n=19) | |
|---|---|---|
| | Days | Years |
| $\overline{X} \pm s\overline{x}$ | 1432.05±22.49 | 3.92±0.38 |
| V% | 8.75 | 9.83 |
| Min. | 1154 | 3.1 |
| Max. | 1550 | 4.3 |

***Notes:*** *n=number of broodmares;* $\overline{X} \pm s\overline{x}$ *= arithmetic mean + standard error of the mean; V% = coefficient of variation; Min.= minimum absolute value of age of introduction to reproduction; Max. = maximum absolute value of age of introduction to reproduction.*

Table 2 The age at first successful insemination of Shagya Arabian broodmares

| Specification | The age at first successful insemination (n=19) | |
|---|---|---|
| | Days | Years |
| $\overline{X} \pm s\overline{x}$ | 1397.53±107.63 | 3.79±0.29 |
| V% | 7.7 | 7.71 |
| Min. | 1173 | 3.2 |
| Max. | 1545 | 4.2 |

***Notes:*** *n=number of broodmares;* $\overline{X} \pm s\overline{x}$ *= arithmetic mean + standard error of the mean; V% = coefficient of variation; Min.= minimum absolute value of age; Max. = maximum absolute value of age.*

**Discussion on gestation length** – this is an essential indicator in equine reproductive biology, influencing foaling planning, foal health, and the efficiency of the reproductive cycle. In Shagya Arabian breed, as in other horse breeds, gestation has a relatively constant duration but can vary depending on several biological and environmental factors. According to the literature, the average gestation length is approximately 340–345 days, with a range of 310 - 412 days, influenced by factors such as the mare's age (first and last pregnancies are often longer), foal sex (male foals generally have longer gestations), climatic conditions (tropical climates shorten gestation compared to temperate or cold climates), and management practices (optimal nutrition and care can slightly reduce gestation length) [1,3-5,9,11]. For the first gestation, the length ranged between 328 - 444 days,

with a mean of 347.2±28.02 days; for the second one, the period had limits between 323 - 351 days, with an average of 337.08±8.95 days across the studied mares, and for the third gestation, the length varied between 316 days (the gestation of one of the broodmares ended in abortion) and 357 days, with a mean of 339.50±14.54 days; the coefficient of variation values indicated that the population is homogeneous with respect to gestation length (Table 3).

Table 3 The gestation length in Shagya Arabian broodmares

| Specification | Gestation length (days) | | |
|---|---|---|---|
| | First gestation (n=15) | Second gestation (n=13) | Third gestation (n=6) |
| $\overline{X} \pm s\overline{x}$ | 347.20±28.02 | 337.08±8.95 | 339.50±14.54 |
| V% | 8.07 | 2.65 | 4.28 |
| Min. | 328 | 323 | 316 |
| Max. | 444 | 351 | 357 |

***Notes:*** *n=number of broodmares;* $\overline{X} \pm s\overline{x}$ *= arithmetic mean + standard error of the mean; V% = coefficient of variation; Min.= minimum gestation length; Max. = maximum gestation length.*

The gestation length in mares, including Shagya Arabians, remains relatively consistent but is modulated by biological, environmental, and management factors, highlighting the importance of careful reproductive planning to ensure optimal foal development and mare health. When comparing the gestation length obtained for each analyzed case with the data from literature (345 days for this species [9]). The variations in gestation length of Shagya Arabian mares monitored at Rădăuți Stud Farm were influenced by factors such as the sex of the foal and the breeding season (Fig. 1). These values are similar to those reported in the literature for other sport or warmblood breeds, confirming the relative consistency of this physiological parameter in horses [1,3,9,11-13].

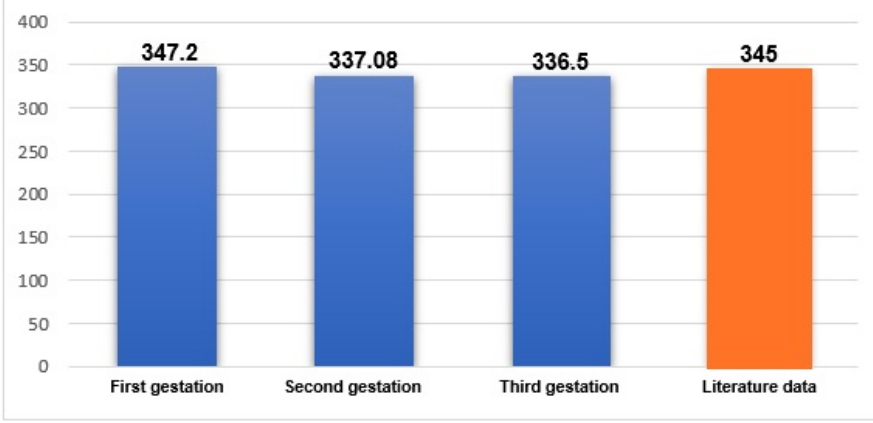


Fig. 1 The average values of gestation length (days)

The service period (SP) represents the interval between foaling and conception at the subsequent successful mating and is an essential indicator for evaluating reproductive efficiency and the management of equine breeding herds. Out of the 19 mares included in the study, only 15 conceived, with foalings occurring across three consecutive years. After the first foaling, SP ranged from 12 - 798 days, with a mean of 210.62±79.5 days. This wide variation was primarily due to several mares

conceiving only one year or more after foaling. Following the second foaling, SP averaged 113.86±115 days, ranging between 12 and 358 days, while after the third foaling, SP averaged 12 days, with only two mares included in this group; the coefficient of variation values (SP1 had V%=130 and SP2 had V%=136) indicated that the population is very heterogeneous with respect to SP (Table 4).

Table 4 The service period length in Shagya Arabian broodmares

| Specification | Service period length (days) | | |
|---|---|---|---|
| | First SP (n=13) | Second SP (n=7) | Third SP (n=2) |
| $\overline{X} \pm s\overline{x}$ | 210.62±79.5 | 113.86±155 | 12±0.0 |
| V% | 130 | 136 | 0 |
| Min. | 12 | 12 | 12 |
| Max. | 798 | 358 | 12 |

***Notes:*** *n=number of broodmares; $\overline{X} \pm s\overline{x}$ = arithmetic mean + standard error of the mean; V% = coefficient of variation; SP=service period; Min.= minimum absolute value of SP; Max. = maximum absolute value of SP.*

The overall average value for SP was 184.92 days. Service period in Shagya Arabian mares at Rădăuți Stud Farm ranged from 12 - 798 days, influenced by postpartum condition, seasonality, and the number of previous foalings. The length of SP was primarily affected by postpartum physiological status and the seasonality of the estrous cycle. An optimal SP allows for one foaling per year, which is crucial for herd profitability and genetic efficiency [2-4]. Extended SP periods occurred in cases where mares did not conceive or conceived only after intervals of one to 1.5 years, which is economically suboptimal for the stud farm. Considering that the average service period (SP) reported in the literature is approximately 60-90 days [9], while the mean SP calculated for the mares analyzed in this study was 184.92±251 days. Although 61.53% of the values recorded for SP1, 71.42% for SP2, and 100% for SP3 fell within the range described in the specialized literature (60–90 days for the service period parameter), the average values for each individual mare indicated that only 61.53% of the females were within the range reported in other related studies. This result highlights the need to optimize the reproductive management process in order to increase the achieved percentage, so that, as much as possible, all mares fall within the recommended interval. By reducing the length SP, a shorter interval for obtaining a new foal could be achieved, which represents a primary objective in the management of such breeding units.

**Discussion on Foaling Interval (FI)** – this parameter represents the period of time between two consecutive foalings of the same mare. It is a key indicator of reproductive efficiency in horse populations, reflecting how well gestation periods, post-partum recovery, and subsequent mating are managed [3].

In the studied population of Shagya Arabian mares at Rădăuți Stud Farm, during the study period, the foaling interval results were as follows: after the first foaling, the FI averaged 495±178.62 days, ranging from 344 to 761 days [13]; after the second foaling, the FI averaged 412.17±121.39 days, with variations between 329 and 655 days. The overall mean foaling interval for the 15 mares that registered gestations during the study period was 367.08±170.14 days, with a range of 172 - 696.5 days; the coefficient of variation values (FI 1 had V%=36.01 and FI 2 had V%=29.45) indicated that the population is very heterogeneous regarding this parameter (Table 5).

Table 5 The FI values in Shagya Arabian broodmares

| Specification | Foaling interval length (days) | |
|---|---|---|
| | First FI (n=15) | Second FI (n=3) |
| $\overline{X} \pm s\overline{X}$ | 495±178.62 | 412.17±121.39 |
| V% | 36.01 | 29.45 |
| Min. | 344 | 329 |
| Max. | 761 | 655 |

***Notes:*** *n=number of broodmares;* $\overline{X} \pm s\overline{X}$ *= arithmetic mean ± standard error of the mean; V% = coefficient of variation; FI=foaling interval; Min.= minimum absolute value of FI length; Max. = maximum absolute value of value of FI length.*

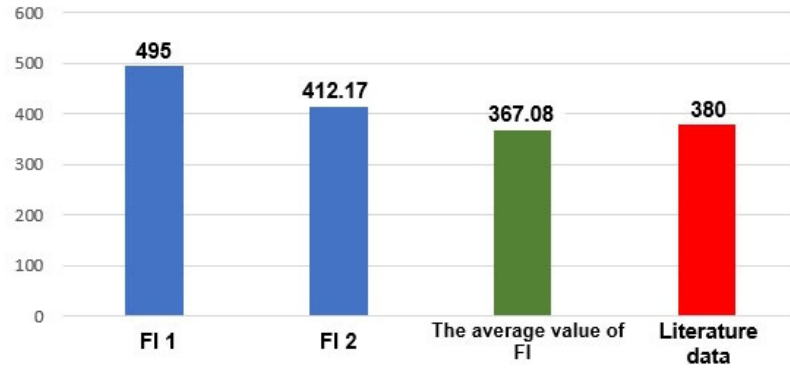


Fig. 2 The average values of FI (days)

These values (an average of 495 days for FI 1, 412.17 days for FI 2 – Fig. 2) reflect situations when the reproductive management does not align with the strategic goal of producing one foal per mare per year. The optimal foaling interval (FI) is approximately 365–380 days, corresponding to one foaling per year – all the other cases were comprised in this interval [13]. In stud farms, an FI of up to 400–420 days is considered acceptable in cases of late foaling, post-partum complications, or lack of synchronization with the stallion or artificial insemination. Extended intervals beyond 400 days have been associated with post-partum complications and conception failures at the first mating

## CONCLUSIONS

The study of reproductive activity in Shagya Arabian mares from the 2016–2018 generations at Rădăuți Stud Farm revealed several key findings. The average age at first breeding was 3.92 years (1432 days), with a range of 3.1–4.3 years, while the average age at first successful mating was 3.79 years (1397.53 days), ranging from 3.2 to 4.2 years. First conceptions typically occurred in the spring of the year when mares reached approximately 3.5 years, aiming for a first foaling at around 4.5 years.

The mean age at first foaling was 4.22±0.81 years, consistent with current breeding recommendations. Gestation length showed moderate variability, with the first gestation averaging 347.2 days, the second 337.08 days, and the third 327.43 days.

Service periods (SP) exhibited substantial variation, with SP1 averaging 210.62 days (range 12–798), SP2 113.86 days (range 12–358), and SP3 12 days, resulting in an overall mean SP of 184.92 days. Foaling intervals (FI) were longer than the optimal target, averaging 495 days after the first foaling and 412.17 days after

the second, with a mean FI across mares of 367.08 days (range 172–696.5), indicating opportunities for optimizing reproductive management.

These results highlight the importance of improving management practices to reduce service periods and align foaling intervals with the goal of producing one foal per mare per year (when the situations require), enhancing both productivity and genetic efficiency within the stud farm.

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